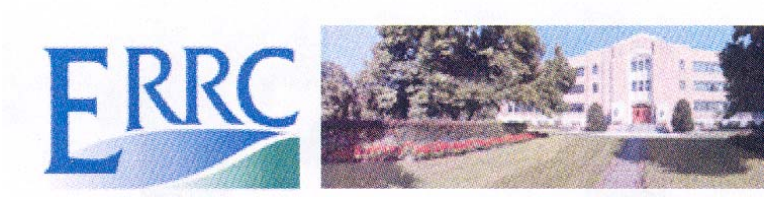

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The VSV Surface Intervention Process

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Post-harvest thermal processes such as blanching, cooking can destroy harmful bacteria on foods. However, raw foods harbor bacteria, sometimes pathogenic bacteria. The many recalls attest to the occurrence of bacteria slipping through the food system to product distribution.

Raw foods such as chicken harbor bacteria in and on the surface. Salmonella and Campylobacter are two common pathogenic bacteria found on chicken that are harmful to humans. It is extremely rare for anyone to eat raw chicken. It's usually cooked so raw chicken normally does not infect humans directly with harmful bacteria. However, cross contamination from chicken can infect people with pathogens associated with chicken.

Steam can kill bacteria but will thermally damage the chicken surface. If steam is applied very rapidly for a short time to a chicken surface and immediately cooled there is virtually no thermal damage (Morgan, et al., 1996a). A thin layer of air and water on the surface interferes with the rapid treatment. Morgan, et al. (1996b) developed a concept in which these layers of air and water are first removed by vacuum. Then saturated steam is rapidly applied and reaches into the pores that harbor bacteria. A second application of vacuum rapidly evaporatively cools the surface stopping any thermal damage.

Goldberg (Morgan, et al., 1996a) developed a machine capable of evacuating the surface, applying saturated steam, and evacuating the surface again in less than 1 s. The usual steam exposure time is 0.1 s. The process is called the Vacuum/Steam/Vacuum (VSV) surface intervention process. The short treatment time is sufficient to kill bacteria yet short enough to prevent thermal damage to the chicken surface. Many chicken slaughter lines operate at approximately 1 carcass per s. Morgan, et al. (1996a) achieved 2 – 2.5 log bacteria kills on inoculated spots on chicken parts.

Kozempel, et al. (2000a) showed that cycling the treatment enhanced the bacteria kill. This is understandable because the condensing steam immediately forms a

resistance layer to further treatment. By cycling between vacuum and steam, the condensed steam is removed and fresh steam contacts the surface.

The Vacuum/Steam/Vacuum (VSV) process is a rapid process and should be able to keep up with typical line speed in a process plant. Typical total treatment times are 1 – 2 s. The original objective was to develop a process to kill bacteria on chicken with no thermal damage. Ideally, the process would kill at least 5 log bacteria on chicken. However, chicken presented many difficulties. It is wet from upstream processing. It has numerous "hiding places" such as under the wings, under the legs, in the skin folds especially at the top and bottom. The worst hiding place is in the visceral cavity. Chicken carcasses are also very susceptible to both thermal and mechanical damage. The skin and meat readily reveal thermal damage and the carcasses rip easily. In spite of these obstacles, the process kills 1 – 1.5 log of bacteria with little or no thermal damage and no mechanical damage. Pilot plant results were confirmed with field trials using a mobile processor testing for naturally present Campylobacter and E. coli.

The VSV process was applied to various other foods, most notably hot dogs. Up to 5 log reduction of inoculated L. innocua were achieved with hot dogs. This application is currently under commercial development through a Cooperative Research and Development Agreement (CRADA). The process was also successfully applied to whole deli-ham with bacteria reduction of 1 – 2 log and to whole eviscerated catfish with bacteria reduction of 2.0 logs.

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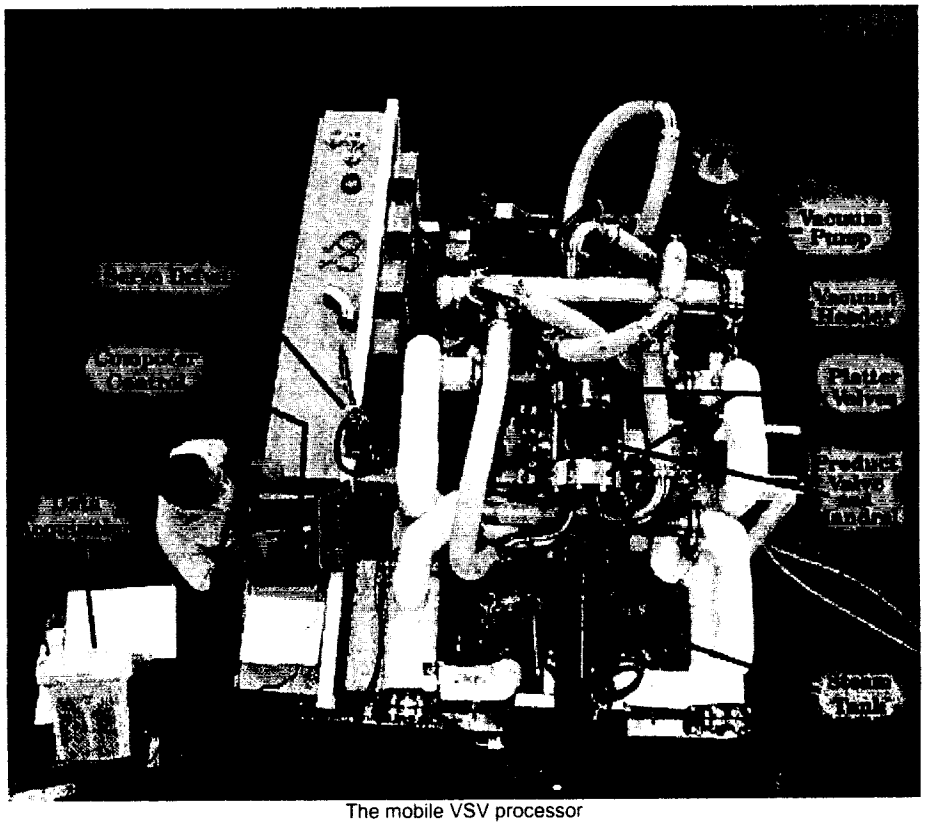

The mobile VSV processor

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